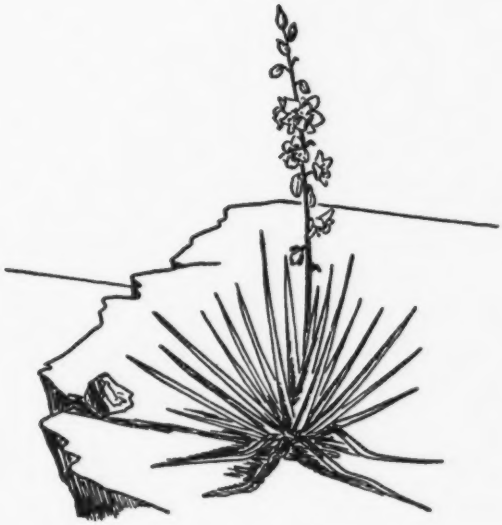
THE SOUTHWESTERN NATURALIST



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THE SOUTHWESTERN NATURALIST 2 (4): 135–139 OCTOBER, 1957

INFLORESCENCE DEVELOPMENT IN TAMARIX PENTANDRA PALLAS (TAMARICACEAE)[1]

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ABSTRACT. *Tamarix pentandra* Pallas (as treated in Kearney & Peebles' *Arizona Flora*) was observed on the Salt River in Arizona blooming in early spring with racemes on last season's wood. A month later terminal panicles were formed on new shoots; a succession of these panicles continued forming until the last bloom in September. This indicates that the plant observed is in the group *Vernali-Aestivales* rather than the *Aestivales* as formerly reported for *Tamarix pentandra*.

The genus *Tamarix* is receiving widespread attention because extensive stands of salt cedar (a deciduous species) have developed in the last half century along rivers and on flood plains and reservoir deposits of Arizona and New Mexico (Thompson, 1957). These stands used much water that might have been available for agricultural and other domestic use in the recent drought years (Gatewood et al., 1950).

In addition to the aggressive species, the evergreen *T. aphylla* (L.) Karsten is frequently planted in the desert areas but has rarely become naturalized. *T. tetrandra* Pallas, another deciduous species, is sometimes cultivated and should be expected as an escape along the rivers and irrigation ditches, unnoticed among the heavy stands of the more common species.

Much confusion exists as to the proper nomenclature for the deciduous species most common in Arizona and the Southwest. McClintock (1951) has shown that it is *Tamarix pentandra* Pallas rather than *T. gallica L.* as formerly thought (Kearney and Peebles, 1942). This interpretation has been accepted by the later work of Kearney and Peebles (1951). According to Bailey (1949) and McClintock (1951) both *T. pentandra* and *T. gallica* have terminal panicles that appear in the summer on the current year's branches. *Tamarix tetrandra* Pallas, on the other hand, has flowers that appear in the spring as lateral racemes on last season's wood.

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[1] See "Salt Cedars (*Tamarix*, Tamaricaceae) of the Soviet Union, by S. G. Gorschkova, Translation and Commentary," by Lloyd H. Shinners, S.W. NAT. 2: 48–73, 1957. This had not yet been published when Mr. Horton's manuscript was received. (Editor's note.)

[2] Forest Service, U. S. Department of Agriculture, general headquarters maintained at Fort Collins, Colorado, in cooperation with Colorado State University. The research reported here was done at Tempe, Arizona, in cooperation with the University of Arizona and Arizona State College.

In a study of the *Tamarix* occurring in Israel, Zohary (1956) discussed the separation of the genus into species blooming in the spring (Vernales) and summer (Aestivales) as originally proposed by Bunge (1852). He also mentions that Maire (1935) in a discussion of North African tamarisk, added a third group (Vernali-Aestivales) consisting of species that bloom in both spring and summer.

Fig. 1. Tamarisk shoot, April 5, 1957. Remains of last year's growth (1). Lateral racemes in full bloom (2). Side shoot (3) developing among the racemes is beginning to show buds. Scale in centimeters.

In 1957, detailed observations were made on several tamarisk shrubs growing along the Salt River east of Tempe, Arizona, about one mile upstream from Granite Reef Diversion Dam, just east of the boundary of the Tonto National Forest. The first collection was made when the tamarisk was beginning to bloom. These earliest flowers appeared as lateral racemes on old wood of the previous year (Fig. 1). In all flowers observed, there were five stamens inserted between lobes of the disc, with blunt and mucronate anthers. Thus, floral characteristics indicated that the shrubs were *T. pentandra*, even though the season of blooming and type of inflorescence was contrary to published descriptions.

Several weeks later the same shrubs began producing terminal panicles on shoots developed since the beginning of the growing season (Fig. 2). These shoots often formed on the same branches that produced the spring racemes. A still further stage of flowering occurred as the central stem of the panicle elongated to develop a secondary panicle after the first one had produced seed.

Growth of these plants during 1957 is given in the following chronology:

Feb. 12 Buds swelling.

Feb. 20 Shoots 3.2 cm.

Mar. 4 Shoots 6.0 cm., raceme buds average 3.6 cm.

Mar. 15 Shoots 7.6 cm., racemes starting to bloom.

Apr. 5 Racemes nearly in full bloom. The developing panicles just beginning to show budding (Fig. 1).

Apr. 12 Raceme bloom almost over. Seeds starting to fly.

May 3 A few racemes still in seed but most seed have been shed. Earliest panicles nearly in full flower (Fig. 2).

May 28 Earliest panicles in seed, others in full bloom, and still others just beginning to show buds, remnants of raceme about shed.

Aug. 8 New blooming shoots still forming in tips of old panicles.

Sept. 30 A few scattered seeds still left on panicles.

These observations indicate that *T. pentandra* belongs to the Vernali-Aestivales group rather than the Aestivales group as previously reported because the shrubs produce both spring racemes and terminal panicles in late spring and summer. Future descriptions and keys should include this characteristic. The other species should also be examined to see whether they bloom during the two seasons.

Shrubs of *T. tetrandra* growing at Boyce Thompson Arboretum, Superior, Arizona, bloomed only in the spring of 1957, and no subsequent panicles were formed.

Fig. 2. Same tamarisk branch as figure 1, May 3, 1957. Many of the lateral racemes have shed all seeds but some are still in capsule stage (1). Terminal panicle (2) is well developed and in bud just prior to bloom. The shoots which will grow into a secondary panicle are forming at the tips of the branches (3). Scale in centimeters.

ACKNOWLEDGMENTS

The two figures were drawn by Dennis C. Jackson, Department of Biological Sciences, Arizona State College, Tempe, Arizona.

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THE SOUTHWESTERN NATURALIST 2 (4): 140–151 OCTOBER, 1957

SYNOPSIS OF THE UNITED STATES SPECIES OF FORESTIERA (OLEACEAE)

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ABSTRACT. Key, principal synonymy, and distribution (based largely on collections in the U.S. National Herbarium) are given for 9 accepted species, 3 of these with 2 varieties each: *F. segregata* (Jacq.) Krug & Urban (syn.: *F. porulosa*) with var. *pinetorum* (Small) n. comb., *F. angustifolia* Torr. (incl. *F. texana* and its var. *Palmeri*), *F. puberula* Eastw., *F. Shrevei* Standl., *F. acuminata* (Michx.) Poir. with f. *vestita* (E. J. Palmer) n. comb., *F. neomexicana* Gray and its var. *arizonica* Gray, *F. pubescens* Nutt. and its var. *glabrifolia* Shinners, *F. ligustrina* (Michx.) Poir. (incl. *F. autumnalis*; syn. *F. Wrightiana*), *F. reticulata* Torr.

Forestiera, a genus of perhaps 20 species of shrubs and small trees of North and Central America, was last revised a century ago by Gray (1860). Gray (1878) later offered a synopsis of the United States species. The necessity to determine the status of certain names proposed in the last 80 years has led to the following synopsis. An attempt was made to evaluate the Mexican and Central American members of this genus, but a paucity of exsiccatae and little field knowledge of the taxa indicated that an extension of this synopsis to them would be of little value, and the Mexican plants are here mentioned only insofar as their status has a bearing on the nomenclature of those of the United States. Suffice it to say that the treatment by Standley (1924) accounts for essentially all the published Mexican taxa. Two additional Central American species have been described: *F. cartaginensis* Donn. Sm. of Guatemala, and *F. hondurensis* Standley & L. O. Williams of Honduras. *F. rhamnifolia* Griseb. has been collected in British Honduras.

Thanks are due the staff of the United States National Herbarium for kindnesses during visits there, especially Dr. Lyman B. Smith; and to Dr. Lloyd H. Shinners, of Southern Methodist University, for going over this synopsis critically and giving it the benefit of his field and herbarium experience with the genus.

FORESTIERA Poir., Encycl. Suppl. 1: 132, 1810, was supplied as a new name for "Adelia Michx." (Fl. Bor.–Am. 2: 223, 1803); however, Richard did not propose a new genus in Michaux's Flora, but was using "Adelia Brown." (P. Browne, Hist. Jam. p. 361, tab. 36, fig. 3, 1756). *Borya* Willd. Sp. Pl. 4: 711, 1806, has the same basis as *Forestiera* Poir. but is pre-empted by *Borya* Labill., 1804.

Adelia P. Br. has been rejected in favor of the euphorbiaceous genus *Adelia* L. Syst. ed. 10, p. 1298, 1759 (lectotypified by *A. Ricinella* L.). The failure of the International Code of Botanical Nomenclature to provide for the rejection of post-1753 genera which were not combined necessary the conservation of *Adelia* L. Linnaeus' *Adelia* did not contain the element which was the basis of Browne's *Adelia*, nor did Linnaeus account for Browne's plant in the 10th edition of the Systema, nor in the second or third editions of the Species Plantarum. The only element which Browne included was "Adelia foliis obovatis, oppositis; spicillis a[xil]laribus; cortice cinereo," which was the basis (partly) of *Borya cassinoides* Willd.; *B. cassinoides* was also based on a specimen from the herbarium of Richard, Michaux's specimen from "maritimis Floridae," upon which Richard based the *Adelia porulosa* of Michaux's Flora. Both *A. porulosa* and *B. cassinoides* are considered synonyms of *Forestiera segregata* (Jacq.) Krug & Urban. It seems clear that *Adelia porulosa* Michx. should be the type species of *Adelia* P. Br. (and thus of *Forestiera* Poir.), and not *Adelia acuminata* Michx., selected by Britton & Brown (Ill. Fl., ed. 2, 2: 728, 1913) merely on the grounds that it was the only one of Michaux's three species which was illustrated.

The key below is fairly "natural" but is not primarily intended to be. One would hardly go along in setting up a distinct genus (*Carpoxis* Raf.) for the serrulate-leaved species. Specimens can be keyed successfully only when mature leaves are present; subtle differences in flowers and fruit (both mature and immature) and in bark and stem configuration are valuable when comparative herbarium material is available, but I have not been able to construct a reliable key using such characters. Fully mature fruit is so seldom present in exsiccatae, and characters of immature fruit are so seldom stable and applicable to mature fruit from the same plant, that I do not use fruit characters in the key except in one instance; even there the characters are not likely to be helpful. Several of the species (*F. segregata*, *F. ligustrina*, *F. reticulata*, and in some seasons *F. angustifolia*, *F. puberula*, and *F. Shrevei*) flower after the leaves are already expanded (*F. segregata* is apparently evergreen). The remainder seem to flower only just before the leaves expand. In *F. angustifolia*, *F. puberula*, and *F. Shrevei*, the leaves, or some of them, fall during droughts but tend to stay on when water is sufficient, regardless of season; thus the flowering can occur more than once a year in different areas, though it usually occurs late in the spring. The flowering is exclusively vernal in *F. acuminata*, *F. neomexicana*, and *F. pubescens*. Consideration of

the ranges will afford strong clues to identity of particular specimens, and in the absence of comparative material may be the only means of determining leafless flowering branches.

KEY

1. Leaf-margins never toothed 2
   2. Leaf-blades obovate or elliptic, widest about ¼ to ½ length from the rounded apex, mostly over 8 mm wide ..... 1. *F. segregata* (Jacq.) Krug & Urban
   2. Leaf-blades linear-oblong or oblanceolate, widest rather near the rounded apex, mostly not over 6 mm wide 3
      3. Plants glabrous ..... 2. *F. angustifolia* Torr.
      3. Leaf-blades, at least below, puberulent (use magnifier)..... 4
         4. Leaf-blades less than 4 mm wide at the widest ..... 3. *F. puberula* Eastwood
         4. Leaf-blades mostly more than 4 mm wide at the widest ..... 4. *F. Shrevei* Standley
1. Leaf-margins toothed, but the teeth sometimes few and small (use magnifier) 5
   5. Plants flowering in spring before the leaves expand; maturation of the fruits continuing all summer 6
      6. Leaf-blades mostly more than 3.5 cm long, acuminate at base and usually also at apex, but sometimes merely acute at apex ..... 5. *F. acuminata* (Michx.) Poir.
      6. Leaf-blades mostly less than 3.5 cm long (rarely up to 4 cm or more), acute or rounded at apex, acuminate at base 7
         7. Leaves including petioles mostly more than twice as long as broad, usually glabrous, fruiting pedicels 2–4 mm long, fruits 5–8 mm long ..... 6. *F. neomexicana* Gray
         7. Leaves including petioles about twice as long as broad or less, rarely more; usually pubescent; fruiting pedicels 2–7 mm long, fruits 6–9 mm long ..... 7. *F. pubescens* Nutt.
   5. Plants flowering after the leaves have already expanded; fruits maturing in late summer and fall 8
      8. Leaves acuminate at base, weakly acute or rounded at apex, widest near the middle, not pronouncedly coriaceous nor reticulate-veined ..... 8. *F. ligustrina* (Michx.) Poir.
      8. Leaves rounded at base, acute or rounded at apex, widest below the middle, coriaceous and reticulate ..... 9. *F. reticulata* Torr.

1. FORESTIERA SEGREGATA (Jacq.) Krug & Urban, Engler Bot. Jahrb. 15: 339, 1892, based on *Myrica segregata* Jacq. Collect. 2: 275, 1788, and Icones Rar. 3, tab. 625, 1793. Two varieties occur in the United States:

1a. F. SEGREGATA var. SEGREGATA. Syn. *Adelia porulosa* Michx. Fl. Bor.–Am. 2: 224, 1803. Collected "in maritimis Floridae" by Michaux (P, not seen). *Borya cassinoides* Willd. Sp. Pl. 4: 711, 1806, based on the original *Adelia* P. Br. Hist. Jam. p. 361, tab. 36, fig. 3, 1756, from Jamaica, and the Michaux specimen. *Forestiera porulosa* (Michx.) Poir. Encycl. Suppl. 2: 664, 1811. *Forestiera Jacquiniana* Didrichs. ex Schlecht. Linnaea 29: 737, 1858, based on *Myrica segregata* Jacq. *Adelia globularis* Small, Bull. N. Y. Bot. Gard. 3: 433, 1905. "The type specimens were collected on sand ridges east of St. Augustine, Florida, by the writer [Small], November 29, 1903 (fruit), and by Mr. P. Wilson and the writer, at the same station, May, 1904 (nos. 2013, 2017, and 2034, flower)." (NY?, not seen; apparent syntype seen, US). *Forestiera globularis* (Small) Small, Shrubs of Florida, p. 107, p. 133, 1913 ("*globosa*," *sphalm.*), based on the last.

1b. FORESTIERA SEGREGATA var. **pinetorum** (Small) M. C. Jnstn., n. comb., based on *Adelia pinetorum* Small, Bull. N. Y. Bot. Gard. 3: 433, 1905. "The type specimens were collected in the pinelands between Homestead and Camp Jackson by Dr. Britton, March, 1904 (no. 209, fruit), and by Mr. P. Wilson and the writer [Small], May, 1904 (nos. 1600 and 1883, flower)." (NY?, not seen). *Forestiera pinetorum* (Small) Small, Fl. Miami, p. 143, p. 200, 1913, based on the last.

Plants of the typical variety occur in coastal areas, hammocks in brackish marshes, mangrove swamps, and low pinelands, in the West Indies, Florida, and southeastern Georgia. They were reported (as *F. porulosa*) in Georgia only recently (Thorne, 1951: 42); I have seen specimens from Altamaha Sound, *J. A. Harris 21105* (US), collected April 28, 1921; since these were determined (as *F. porulosa*) by "J.K.S." (Small), it seems curious that Small did not report the species in Georgia in his 1933 Manual; perhaps it was because the specimens were sterile.

In pinelands of southern Florida occur the narrow-leaved plants of the var. *pinetorum*, apparently on higher, drier ground than the broad-leaved plants. Small thought these plants were "related to the western *Adelia angustifolia*," but this is far-fetched, to say the least.

Plants of both varieties are shrubs flowering during the period July through January, and maturing fruit from September to May.

VAR. SEGREGATA: FLORIDA: Brevard, Broward, Dale, Hillsborough, Lee Pinellas, Sarasota. GEORGIA: Glynn.

VAR. PINETORUM: FLORIDA: Dade.

2. FORESTIERA ANGUSTIFOLIA Torr. Bot. Mex. Bound. p. 168, 1859. LECTO-TYPE: Western Texas near the Rio Grande, *Wright exs. 566* (NY?, not seen; apparent isotype, bearing this number, US, seen). Other specimens were cited by Torrey (not seen): Lindheimer's from New Braunfels and the shore of Matagorda Bay; *Berlandier 3024* from Matamoros, Tamaulipas; and a Gregg collection from Mexico. *Forestiera porulosa* var. *? angustifolia* (Torr.) Gray, Proc. Am. Acad. 4: 365, 1860, based on the last. *Forestiera texana* Cory, Madroño 7: 252, 1944. Nine miles south southeast of La Feria, Cameron County, Texas, April 4, 1938, *Cory 28393* (A-GH, TAES, not seen). *Forestiera texana* var. *Palmeri* Cory, Madroño 7: 253, 1944. Val Verde County, Texas, June 29, 1917, *E. J. Palmer 12372* (A-GH, not seen). *? Forestiera phillyreoides* var. *spathulaefolia* Torr. Bot. Mex. Bound. p. 167, 1859. "Near Monter[r]ey, Neuvo Leon [sic], and plains west of San Pablo; *Gregg.*" (NY?, not seen).

These are the glabrous shrubs of brush, occurring from Tamaulipas, Nuevo Leon, and eastern Coahuila north to Val Verde, Uvalde, Comal, Travis, and Matagorda counties, Texas. My field and herbarium records indicate that these plants can flower during all months from January through July, and in August and September; fruits set during the earlier flowering period mature some time during the period July to December, and those set in the August-September flowering period mature some time during the period January through April of the following year. Only rarely are plants found in flower still retaining fruit from the previous setting.

The characters which Cory evokes to distinguish his *F. texana* and its var. *Palmeri* are not useful, and his "typification" of *F. angustifolia* by one of his own collections is not tenable, to say the least. The degree of fasciculation of the leaves is very variable; during relatively moist seasons the short lateral branches, which ordinarily would bear the fascicles of leaves, may elongate into slender flexuous branches, but I have often seen varying degrees of fasciculation of leaves on single plants. The plants of the drier uplands in the western part of the range are more regularly fasciculate-leaved than the plants of the somewhat more moist lowlands of the Rio Grande delta. The tendency to fasciculation, if it is to be given a name, may be represented by the *F. phillyreoides* var. *spathulaefolia* Torr. One might expect that a plant given a varietal name under *F. phillyreoides* would be quite different from *F. angustifolia*, at least in some way pubescent, but apparently Torrey did not know *F. phillyreoides* except by its description and did not realize that it is a very different central Mexican species. Gray (1878) listed the var. *spathulaefolia* as a direct synonym of *F. angus-*

tifolia, and we will follow him, though the type specimens may rather be referable to *F. puberula*.

TEXAS: Aransas, Brewster (?), Calhoun, Cameron, Comal, Duval, Jackson, Hidalgo, Kenedy, Kinney, LaSalle, Matagorda, Maverick, Nueces, Starr, Uvalde, Val Verde, Webb, Willacy, and Zapata.

3. FORESTIERA PUBERULA Eastwood, Proc. Am. Acad. 44: 605, 1909. "In arroyas [sic], Cedros, Zacatecas, June, 1908," *J. E. Kirkwood 12* (GH, not seen).

These are shrubs of pene-desert scrub of northern San Luis Potosi, northeastern Zacatecas, western Coahuila, eastern Durango, eastern Chihuahua, and trans-Pecos Texas. They have leaves which are to some extent puberulent, either strictly on the lower surface or on both surfaces. Herbarium dates indicate that the plants flower in spring and early summer and mature fruit in the late summer and fall, but again the flowering dates are by no means constant.

These shrubs are in general more irregularly branched and gnarled than are those of *F. angustifolia*. But the resemblance is great, and no doubt they pass into each other in Trans-Pecos Texas. The only United States specimen I have seen was from Presidio County, Texas. However, a sheet from Bone Spring, Brewster County, which I have referred doubtfully to *F. angustifolia*, has puberulent branchlets. Cory (1944: 254) cites a specimen of dubious identity from the Chisos Mountains, Brewster County, with some foliage pubescence.

4. FORESTIERA SHREVEI Standley, Field Mus. Publ. Bot. 17: 205, 1937. "Above Alamo Ranch, Ajo Mountains, Pima County, Arizona," 720 meters elev., March 19, 1933, *Shreve 6201* (F, not seen). The use of the name "*F. phillyreoides* (Benth.) Torr." for these Arizona plants seems to date from about 1920 (Bartram, 1922: 247); it has been continued in late manuals (Kearney & Peebles, 1951; Benson & Darrow, 1954). *F. phillyreoides* is a species of very different plants of the high deserts of central Mexico.

Fairly typical plants of *F. Shrevei* appear to be almost restricted to Pima County, Arizona. Kearney & Peebles (1951: 643) allow "*F. phillyreoides*" in Cochise, Santa Cruz, Yuma, and Maricopa counties as well, but Benson & Darrow (1954: 276) restrict it to Yuma, Maricopa, and Pima counties. The Maricopa County records are apparently based on specimens from the Sierra Estrella, which are quite like *F. Shrevei* except for being perfectly glabrous (they would therefore not key out in my key). The Yuma County records, on the other hand, may be completely extraneous. I have seen only one specimen from Yuma County, "Palm Canyon, S. H. Mts.", March 31, 1930, *Peebles, Harrison, & Loomis 6765* (US), labelled in Kearney's hand as doubtfully *F. phillyreoides*. One might well doubt. The long, slender,

smooth, pale-barked branchlets bear a few perfectly glabrous nonfasciculate leaves, contrasting with the usually stout, griseous, gnarled branchlets of *F. Shrevei*, bearing pubescent fasciculate leaves. Without more material the identity of this specimen must remain undetermined, but it is definitely not *F. Shrevei*.

The plants of *F. Shrevei* from Pima County are shrubs flowering December through March and maturing fruit some time during the period May through June.

5. FORESTIERA ACUMINATA (Michx.) Poir. Encycl. Suppl. 2: 664, 1811, based on *Adelia acuminata* Michx. Fl. Bor.-Am. 2: 225, tab. 48, 1803. "*Hab.* ad ripas fluviorum Carolinae et Georgiae." But Gray (1860: 364–365) indicates that the habitats of *A. acuminata* and *A. ligustrina* were transposed in Michaux's Flora, so this should read: "*Hab.* in fruticetis Illinoensibus, Tennassée, &c." Poiret saw a specimen (P?) "communiquée par M. Bosc." Perhaps Richard had it from Bosc as well as from Michaux. The name may rest on the original figure if no specimens exist. *Forestiera nitida* Raf. New Fl. N. A. 3: 91, 1838 (alternate name: *Carpoxis nitida* Raf., l.c.), from North America, to be referred to *Adelia acuminata* (according to Merrill, 1945: 91). *Carpoxis spinosa* Raf. New Fl. N.A. 3: 92, 1838, based on *Adelia acuminata* Michx.

These are shrubs of stream margins and river swamps of southeastern United States. They flower in the spring before any leaves appear, and the fruits mature in late summer. Gray (1860: 364) indicates that the leaves of *Adelia acuminata* are "sometimes entire," but I have not seen any specimens in which no serrulations could be seen. The foliage and twigs are usually essentially glabrous or glabrate, but individuals scattered in the range are persistently short-pubescent; this type of plant is not restricted geographically, but scattered throughout the range, so may be called *Forestiera acuminata* forma **vestita** (E. J. Palmer) M. C. Jnstn., n. comb., based on *F. acuminata* var. *vestita* E. J. Palmer, Journ. Arn. Arb. 4: 29, 1923, Miller County, Arkansas, April 27, 1905, *B. F. Bush 2468* (A-GH, not seen).

FORMA ACUMINATA: ALABAMA (?). ARKANSAS: Bradley, Conway, Pope, Marion, Mississippi. GEORGIA: Bibb, Chattooga, Decatur, Richmond. ILLINOIS: Gallatin, Pope, St. Clair (Jones & Fuller, 1955: 370, map 931, indicate the occurrence in 17 counties in Illinois, north to Lawrence and Fulton). INDIANA (6 counties in southwestern part of state, according to Deam, 1940: 754). KENTUCKY (sterile specimen from Marshall). LOUISIANA (?). MISSISSIPPI (?). MISSOURI: Jasper, St. Louis, Stone. TENNESSEE: Davidson (Shanks, 1952: 95, credits the species to western and middle Tennessee as far east as White). TEXAS: Brazoria, Colorado, Hardin, Harris, Matagorda.

FORMA VESTITA: ARKANSAS: Miller, Pulaski. FLORIDA: Hernando, Alachua (?). LOUISIANA (Palmer cites a specimen without locality). SOUTH CAROLINA (Beaufort). TEXAS: Marion.

6. FORESTIERA NEOMEXICANA Gray, Proc. Am. Acad. 12: 63, 1876, based on *Forestiera acuminata* var. *parvifolia* Gray, Proc. Am. Acad. 4: 364, 1860. Type: Near Santa Fe, New Mexico, *Fendler 547* (GH?, not seen). Other specimens cited by Gray in 1860 were *Wright 1699* from below El Paso, and a Bigelow collection from Semeleuque Springs (not located; cf. Shinners Field & Lab. 18: 99, 1950). Two varieties are known:

6a. F. NEOMEXICANA var. NEOMEXICANA, and

6b. F. NEOMEXICANA var. ARIZONICA Gray, Syn. Fl. 2(1): 76, 1878. Near Prescott, Arizona, April, 1876, *E. Palmer* 580 (GH?, not seen; apparent isotype seen, US). Gray had only this April collection with very young leaves, being distinguished from the typical variety in the soft-pubescence of the young shoots and foliage.

These shrubs occur in fairly dry areas of southwestern United States. They flower in March, April, and early May, and the fruit matures in late July through September. The pubescent variety is much more restricted geographically than the typical variety, and, as Kearney & Peebles (1951: 643) say, "seems to connect *F. neomexicana* and *F. pubescens* Nutt." The close relationshp of these two species and the difficulty in keying them out will be apparent from a glance at the key. In addition to variable leaf-shape and pubescence, in some specimens of *F. neomexicana* the serrulation sometimes becomes almost obsolete, especially in specimens from Kern and Alameda counties, California; these would be difficult to key out, but they are in such a small minority that they are ignored in the key. *F. neomexicana* is the only *Forestiera* thus far recorded from California.

VAR. NEOMEXICANA: ARIZONA: Coconino, Gila, Mohave, Navajo, Yavapai (also Graham, according to Kearney & Peebles, 1951: 643). CALIFORNIA: Alameda, Inyo, Kern, Monterey, San Bernardino (also San Joaquin, according to Eastwood, Leafl. West. Bot. 2: 138, 1838). COLORADO: Montrose. NEVADA: Nye. NEW MEXICO: Bernalillo, Grant, Luna, Sandoval, San Juan, Santa Fe, Socorro, Valencia. TEXAS: Brewster, Culberson. UTAH: San Juan. CHIHUAHUA: One specimen, from Salto de Babícora, July 20, 1937, *Harde LeSueur 1420* (US), closely resembles this species, but because of its short leaves would probably key out to *F. pubescens* in this synopsis. More material is needed. This is the only Mexican specimen.

VAR. ARIZONICA: ARIZONA: Yavapai. NEW MEXICO: one specimen, county undetermined, mounted on a sheet with one branch of var. *neomexicana*, one of var. *arizonica*, appearing identical except for the pubescence, with the following label data: Queen, New Mexico, August 1, 1909, *Wooton s.n.* These are sterile specimens.

7. FORESTIERA PUBESCENS Nutt. Trans. Am. Phil. Soc. n.s. 5: 177,

1835. In the prairies of Red river, southern Oklahoma, *Nuttall* (BM?, not seen). We have two varieties of this species:

7a. F. PUBESCENS var. PUBESCENS. Syn. ? *Geisarina verrucosa* Raf. Alsogr. p. 6, 1838, citation and tentative synonymy fide Merrill (1945: 189). ? *Forestiera sphaerocarpa* Torr. Bot. Mex. Bound. p. 168, 1859. "Dry ravines near the Limpio [Limpia Creek, Jeff Davis County, Texas], July (in fruit); *Bigelow.*" (NY? not seen). *F. ligustrina* var. (beta) *pubescens* (Nutt.) Gray, Proc. Am. Acad. 4: 364, 1860, based on *F. pubescens* Nutt.

7b. F. PUBESCENS var. GLABRIFOLIA Shinners, Field & Lab. 18: 99, 1950. Bosque County, Texas, 12½ miles north northeast of Walnut Springs, May 26, 1949, *Shinners 11331* (SMU, not seen). Shinners (1956: 87) refers to his var. *glabrifolia* as "doubtfully distinct." Though it does seem to be a mere form in the eastern part of its range, I preserve it as a variety because it is a significant geographical trend.

These are shrubs of prairies, mottes, and low, scrubby vegetation along upland streams from Choctaw, Caddo, and Kiowa counties, Oklahoma, south to central and central-western Texas. These shrubs flower January through early April and the fruits mature during the period late May through the summer. In the eastern part of the range the vast majority of the plants have pubescent foliage, but a few scattered plants are glabrous; as one goes west in the range, more of the plants are glabrous, and fewer pubescent. There seem to be no other characteristics to distinguish the two varieties. The glabrous condition may be the result of introgressive influence of the very closely related *F. neomexicana* var. *neomexicana.*

Specimens from mountains of trans-Pecos Texas and southeastern New Mexico, representing the southwestern extremes of this species, are probably what Torrey called *F. sphaerocarpa*, and might be distinguished on the slightly more acute leaves. I think they fall within the limits of variability to be expected in *F. pubescens.* Since these specimens are of special interest, I cite them: NEW MEXICO: Eddy or Lincoln Co.: Carlsbad Cave, April, 1924, *V. Bailey s.n.* In or near Lincoln National Forest, 1903, *F. G. Plummer s.n.* TEXAS: Culberson County: McKittrick Canyon, Guadalupe Mountains, rocky slope, shrub 3–5 feet, occasional, August 15–17, 1924, *Standley 40557* (US, leaves only). Jeff Davis County: Davis Mountains, July 14, 1901, *V. Bailey 411* (US).

VAR. PUBESCENS: OKLAHOMA: Caddo, Choctaw, Kiowa. TEXAS: Bell, Burnet, Comal, Cooke, Dallas, Dickens, Gillespie, Kerr, Tarrant, Travis, Wilson.

VAR. GLABRIFOLIA: TEXAS: Bosque, Brown, Coke, Dickens, Garza, Kerr, Mitchell, Palo Pinto, Tarrant, Wise.

8. FORESTIERA LIGUSTRINA (Michx.) Poir. Encycl. Suppl. 2: 664, 1811, based on *Adelia ligustrina* Michx. Fl. Bor.-Am. 2: 224, 1803, "*Hab.* in fruticetis Illinoensibus, Tennassée, &c.", but Gray says this is mistaken (see my note under *F. acuminata*), and should read "*Hab.* ad ripas fluviorum Carolinae et Georgiae." As Gray (1860: 364) points out, Richard mistakenly described the leaves as entire, whereas in fact they are always serrulate. If no specimens exist (P) the name will have to rest on the description. *Forestiera autumnalis* Buckley, Proc. Acad. Nat. Sci. Phila. 14 (1862): 7, 1863. "Eastern Texas and Western Louisiana." *Buckley* (PH, not seen). Gray (Proc. Acad. Nat. Sci. Phila. 14 (1862): 166, 1863), who subordinated *F. pubescens* as a variety of *F. ligustrina*, in effect refers the "specimens of Linsecom and Buckley in Durand's herbarium" to what we now call *F. pubescens*. Shinners (1957) correctly extricates Buckley's name from that synonymy. Shinners (l.c.) was the first to place in synonymy here *Forestiera Wrightiana* Lundell, Am. Mid. Nat. 29: 487, 1943. Newton County, Texas, off U. S. highway 190 in woods above Cow Creek, September 10, 1942, *Lundell & Geiser 11878* (MICH, SMU, not seen).

I have searched for characters which might separate the plants east and west of the Mississippi, but I think range is the only useful criterion. Shinners (l.c.) in establishing *F. autumnalis* as a distinct species, undoubtedly did not have adequate comparative material of *F. ligustrina*. In both parts of the range these shrubs flower from July to September, and the fruits mature in the fall. The degree of pubescence is variable in both parts of the range. The Texas plants appear to have larger leaves as an average, but the range of variation is coextensive. The Texas plants appear to prefer low woods in sandy soil along streams in forested areas; in Tennessee the species is characteristic of calcareous glades and cedar barrens, and in northern Alabama of calcareous uplands, and in Georgia granite flat rocks, as well as sandy stream banks. The fall fruiting branches from both parts of the range are striking and characteristic in their close masses of very short-pedicelled axillary fruit.

ALABAMA: Autauga, Blount, Jefferson, Madison. FLORIDA: Hernando, Levy, Liberty. GEORGIA: Baker, Baldwin, Columbia, DeKalb, Dooly, Newton, Richmond. KENTUCKY (?, cf. Fernald, 1950: 1150). TENNESSEE: Davidson, Rutherford (also Franklin and Lincoln, fide Shanks, 1952: 95). TEXAS: Anderson, Brazos, Freestone, Grimes, Harris, Madison, Matagorda, Newton, Panola, Rusk, San Augustine, Shelby, Walker. Shinners (1957) cites a specimen from Sabine Parish, Louisiana.

9. FORESTIERA RETICULATA Torr. Bot. Mex. Bound. p. 167, 1859. Type: Crevices of rocks and ravines near the Pecos on the Rio Grande, *Schott* (NY?, not seen). Torrey also cited *Wright 565* (NY?) and a

Bigelow collection from "Ravines near White Oak Creek" (locality not determined). Curiously, Torrey said his species resembled *F. porulosa* (Michx.) Poir. (i.e., *F. segregata*). The more obvious comparison would seem to be with *F. ligustrina*. But this species is quite clearly distinct from all else except *F. racemosa* S. Wats. of northeastern Mexico. Standley's attempt (1924: 1139) to separate this species from *F. racemosa* on the grounds that the leaves of *F. reticulata* have "conspicuous pores beneath" hardly fits the facts. Actually the two entities, though distinguishable, are rather closely related, and may be conspecific.

These shrubs occur on limestone slopes and ravines in the southern part of the Edward's plateau, flowering in the summer and maturing fruit in the fall. Texas: Bandera, Medina, Uvalde, Val Verde. (Gray, 1860: 365, indicated the occurrence of this species "along the Limpio," which would be in Jeff Davis County; I have seen no evidence of its occurrence so far west.).

DOUBTFUL NAMES

Carpoxis inermis Raf. New Fl. N. A. 3: 92, 1838, based on plants which Elliott had referred to *Borya acuminata*, thus probably *Nestronia umbellula* Raf., ex char. Merrill (1945: 188) indicates that it was based on plants which Pursh had referred to *Borya acuminata*, and thus was a synonym of *Adelia acuminata* Michx., and indeed can be so considered on a purely nomenclatorial basis.

Nudilus paradoxus Raf. Atl. Journ. 1: 176, 1833. Tennessee to Texas, according to Rafinesque, New Fl. N. A. 3: 92, 1838: "West Kentucky to Texas." Merrill (1945: 190) indicates that the genus is a synonym of *Forestiera* Poir., as indeed it would appear from the description, but I am unable to refer it to one of the species. Rafinesque said it was a rare small all glabrous shrub 3 to 5 feet high, the flowers appearing before the leaves, the leaves commonly alternate (!).

Forestiera prinoides Raf. (Alternate: *Carpoxis prinoides* Raf.) New Fl. N. A. 3: 92, 1838, based on *Borya prinoides* Loudon, Cycl. ?, not seen; Merrill (l.c.) indicates that it is based on *Borya prinoides* Willd. Enum. Hort. Berol. Suppl. [p. 66], 1813 (citation fide Index Kewensis). Rafinesque says merely "Leaves ovate lanceolate serrate—Is it *Ilex prinoides* ? flowers green, leaves 2½ inches long, one broad." Supposedly a North American plant.

Forestiera retusa Raf. (Alternate: *Carpoxis retusa* Raf.) New Fl. N. A. 3: 92, 1838, based on *Borya retusa* Loudon, Cycl. ?, not seen, perhaps Rafinesque means the 1822 or 1829 Encyclopedias of Loudon; Merrill (1945: 189) indicates that the name is based ultimately on *Borya retusa* Willd., Hort. Berol. Suppl. [p. 66], 1813 (citation fide Index Kewensis). On the basis of Rafinesque's description I think this cannot be a *Forestiera;* I have not seen Willdenow's or Loudon's descriptions. This is supposedly a North American plant.

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NOTES ON ARIZONA PLANTS

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ABSTRACT. Records are cited for the following: Charophycophyta-Characeae: *Chara contraria* A. Br. (Maricopa Co.), *C. zeylandica* Klein (with preceding), *C. globularis* Thuill. (Apache Co., Navajo Co.), *Nitella* sp. Angiospermae-Najadaceae: *Najas marina* L. (Maricopa Co.), Hydrocharitaceae: *Vallisneria americana* Michx. (Maricopa Co., new to Arizona). Gentianaceae: *Menyanthes trifoliata* L. (Apache Co.; new to Arizona).

Recent Arizona plant collections have revealed the existence of two species not previously recorded for the state, and noteworthy range extensions of several others. Specimens of the following are in the herbarium of Arizona State College, Tempe. Collections were made by the writer unless otherwise stated.

CHARACEAE

The stoneworts are a little-understood group of plants rather common in the lakes of Arizona. Specimens from several locations were sent to Dr. R. D. Wood, Botany Department, University of Rhode Island, Kingston, for identification. The identifications and comments have been supplied by him. The two genera, *Chara* and *Nitella*, are represented. Additional information on the economic importance of these plants, especially in relation to waterfowl, boating and fishing, and utilization of irrigation water, has been published by Dr. Wood (1952).

CHARA CONTRARIA A. Br. In a small lake at Papago Park, Tempe, Maricopa Co., in about 2 feet of water, October, 1952. "Specimens varying greatly from smooth toward slightly hispid, bracteoles asperoid in appearance, diplostichous with primaries exceeding the secondaries, spines commonly with axillary spinules, predominately female specimens, but occasional whorls showing conjoined gametangia of both sexes. Specimens could be readily mistaken for *Ch. aspera*." Recently this species has been united with the earlier-named *C. vulgaris* L. by Wood and Muenscher (1956).

C. ZEYLANDICA Klein. With the preceding. "Specimens small and fragmentary among the *Ch. contraria*. Heavily fertile, and completely conjoined."

C. GLOBULARIS Thuill. In Woolsey Lake, Apache Co., alt. ca. 7000 ft., June 1956. In Rainbow Lake, Navajo Co., alt. ca. 7100 ft., 20 June 1956. In Showlow Creek, Navajo Co., alt. ca. 7000 ft., June 1956.

NITELLA sp. Insufficient material was sent to Dr. Wood for positive identification, so that species determination must await further collections.

NAJADACEAE

NAJAS MARINA L. In Papago Lake, near Tempe, Maricopa Co., alt. 1100 ft., October, 1956. This plant is not new to the state, for Kearney & Peebles (1951) cite collections from near Fort Mohave, Mohave Co.; near Tucson, Pima Co.; and Crittenden, Santa Cruz Co.; at altitudes from 2500 ft. to 4000 ft. None of these locations is in central Arizona, nor at altitudes as low as Papago Park. The species is cosmopolitan, being widely distributed in the Old World and over much of the United States, southward into tropical America. The irrigation water of the valley from which this collection was male is generally alkaline, substantiating the observations of Rydberg (1923) and Fassett (1940), who both report the occurrence of this species in brackish water.

HYDROCHARITACEAE

VALLISNERIA AMERICANA Michx. "Eelgrass" or wild celery is common in the eastern states from Nova Scotia to South Dakota and south to the Gulf of Mexico (Fassett, 1954). The Arizona specimens were found growing very extensively for a distance of over a mile in a canal of the Salt River Valley irrigation system. It is probable that this disjunct record is due to an escape from a private aquarium; collector, Miss Janet Wien.

GENTIANACEAE

MENYANTHES TRIFOLIATA L. The first Arizona collection was made by Mr. Verl Rhoton at Woolsey Lake, Apache Co., 1947. Later searching revealed the species at other lakes in the same general area. The plant is well established, being scattered over an area of several acres in each instance. This record furnishes an instance of disjunct distribution, the closest known station being in Boulder Co., Colorado (Weber, 1953), a distance of approximately 680 airline miles from Lakeside, Arizona. It is extremely likely that this plant has simply been overlooked in Utah and New Mexico. Since the seeds are very durable

(Muenscher, 1944), and may possibly be used as an occasional food by birds, or adhere to mud on their feet, the plant may thus be transported from one area to another.

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SUMMER FLORA OF THE GENE HOWE WILDLIFE MANAGEMENT AREA, HEMPHILL COUNTY, TEXAS

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ABSTRACT. An annotated check list is given for the Gene Howe Wildlife Management Area, located 7 miles northeast of Canadian, in the northeastern corner of the Texas Panhandle. The Area includes 5,700 acres of floodplains and bottom lands of the Canadian River and rolling sand hills back from the river. The known flora comprises 297 species in 65 families. *Lycopus asper* Greene and *Scutellaria lateriflora* L. are reported from the state for the first time, so far as known. *Agrimonia parviflora* Ait., *Agrostis gigantea* Roth, and *Mentha arvensis* L. were previously recorded for the state, but were not represented by specimens in the principal Texas herbaria. *Lespedeza capitata* Michx. has been collected previously only in Lamar Co., northeastern Texas.

The Gene Howe Wildlife Management Area of 5,700 acres is located 7 miles northeast of Canadian, in the northeastern corner of the Texas Panhandle. It lies along the north bank of the Canadian River, and includes river floodplain, bottom lands, and rolling sand hills back from the River. Two small streams, Clear Creek and Persimmon Creek, flow through the sand hills. Rainfall in the area amounts to about 4.5 in. for the summer (June—August). The temperatures for the same period range from 48° F. to 109° F., with an average of about 81° F.

The vegetation is essentially of three types. The most extensive is that of the sand hills, consisting of stands of plum (*Prunus angustifolia*) and skunkbush (*Rhus aromatica* var. *pilosissima*) in varying densities, associated with a number of grass species. Second largest in area are the grasslands of the river bottoms and the floodplains, exclusive of the water courses. Woodlands along the water courses (creeks and main river bottoms) constitute the third and most limited of the vegetation types. Cottonwood (*Populus* spp.) is the dominant tree overall, but dogwood (*Cornus drummondii*), mulberry (*Morus alba*, china tree (*Sapindus drummondii*), and persimmon (*Diospyros virginiana*) also occur, occasionally in dense stands.

Collections were made by the writer during the summer (1 June—31 August) of 1955, and on one additional trip 13—15 July, 1956. Further collections were made by Mr. Paul Lukens during May and

September, 1955. The first set is housed at the Howe Area. Duplicate sets are deposited at Southern Methodist University and the University of Michigan. The study was carried out during a period of employment with the Texas Game and Fish Commission, Division of Wildlife Restoration. I am very grateful to members of the Division, especially Mr. E. A. Walker, Director, Mr. A. S. Jackson, Wildlife Biologist Leader for the Texas Panhandle, and Mr. J. Parsons, manager of the Howe Area, for their constant interest and enthusiasm. My appreciation is due to Dr. Lloyd H. Shinners of Southern Methodist University for his encouragement and assistance, in addition to his making available to me the excellent facilities of the herbarium and taxonomic library under his direction. I wish also to thank Dr. B. C. Tharp of the University of Texas, and Dr. F. W. Gould of Texas A. & M. College, for the use of the herbaria under their direction.

The known flora of the Howe Area comprises 297 species belonging to 65 families. The Gramineae (56 species), Compositae (48 species), and Leguminosae (23 species) are the three largest families by a wide margin, all other families being represented by fewer than 10 species. Noteworthy species are: *Lycopus asper* Greene and *Scutellaria lateriflora* L., believed to be recorded here for the first time from Texas. *Agrimonia parviflora* Ait., *Agrostis gigantea* Roth, and *Mentha arvensis* L., listed by Cory & Parks (Catalog of the Flora of Texas, Texas Agr. Exp. Sta. Bull. 550, 1937 [issued 1938], were not represented in the three principal herbaria in Texas by collections from the state. *Lespedeza capitata* Michx., not listed by Cory & Parks but mapped for northern Texas by Isely (Iowa State College Journ. Sci. 30: 87, 1955), was represented by specimens from Lamar County, and from the north side of Lake Texoma in southern Oklahoma.

ANNOTATED CHECK LIST OF THE FLORA

EQUISETACEAE

EQUISETUM HYEMALE L. Occasional in moist areas of creek banks and the river bottoms.

TYPHACEAE

TYPHA DOMINGENSIS Pers. Occasional in dense stands in Clear and Persimmon Creeks.

POTAMOGETONACEAE

POTAMOGETON ILLINOENSIS Morong. In sloughs of Clear and Persimmon Creeks. Locally common.

NAJADACEAE

NAJAS GUADALUPENSIS (Spreng.) Morong. In sloughs of Clear and Persimmon Creeks. Locally common.

ALISMATACEAE

SAGITTARIA LATIFOLIA Willd. In sloughs of Clear Creek. Locally common.

GRAMINEAE

AGROPYRON SMITHII Rydb. Occasional in sandy loam of the river bottoms.

AGROPYRON TRACHYCAULUM (Link) Malte. Occasional in sandy loam of the river bottoms.

AGROSTIS GIGANTEA Roth. In stands in scattered areas over the sand hills and in the river bottoms.

ANDROPOGON HALLII Hack. In scattered stands over the sand hills and in the river bottoms.

ANDROPOGON SACCHAROIDES Sw. var. TORREYANUS Hack. Occasional in the river bottoms.

ANDROPOGON SCOPARIUS Michx. var. NEOMEXICANUS (Nash) Hitchc. Occasional stands in deep sands of the sand hills.

ARISTIDA LONGISETA Steud. Occasional small stands in deep sands of the sand hills.

ARISTIDA PURPUREA Nutt. Occasional stands in deep sands of the sand hills and in extensive stands along gravel banks adjacent to the river bottoms.

BOUTELOUA CURTIPENDULA (Michx.) Torr. Occasional in small stands through-out the sand hills but covering large areas in tight soils south of Persimmon Creek.

BOUTELOUA GRACILIS (H.B.K.) Lag. Occasional in both sand hill and river bottoms.

BOUTELOUA HIRSUTA Lag. Occasional through-out sand hills but frequent in large stands on sand hills south of Persimmon Creek.

BROMUS JAPONICUS Thunb. Occasional to infrequent in the river bottoms.

BROMUS SECALINUS L. Occasional to infrequent in the river bottoms.

BUCHLOE DACTYLOIDES (Nutt.) Engelm. Occasional in medium stands in areas of tight sandy soils in the sand hills.

CALAMOVILFA GIGANTEA (Nutt.) Scribn. & Merr. Occasional in dense stands in deep sands of the sand hills.

CENCHRUS PAUCIFLORUS Benth. Locally abundant in disturbed areas in both the sand hills and the river bottoms.

CHLORIS VERTICILLATA L. Occasional in deep sands of the sand hills and adjacent to Clear Creek in the river bottoms.

CHLORIS VIRGATA Sw. Occasional in deep sands of the sand hills.

CYNODON DACTYLON (L.) Pers. Locally frequent near Clear Creek, Persimmon Creek and the river bottoms.

DIGITARIA SANGUINALIS (L.) Scop. Occasional in stands in the river bottoms.

DISTICHLIS STRICTA (Torr.) Rydb. Occasional in dense stands in the river bottoms.

ECHINOCHLOA CRUSGALLI (L.) Beauv. var. ZELAYENSIS (H.B.K.) Hitchc. Occasional to frequent in the river bottoms.

ELYMUS CANADENSIS L. Occasional, scattered, in the river bottoms.

ERAGROSTIS CILIANENSIS (All.) Link. Of scattered occurrence throughout the sand hills.

ERAGROSTIS CURTIPEDICELLATA Buckl. Occasional to locally frequent in sands adjacent to Persimmon Creek.

ERAGROSTIS CURVULA (Schrad.) Nees. Infrequent in bottoms of the river and near the mouth of Clear Creek.

ERAGROSTIS OXYLEPIS Torr. Occasional to frequent through-out the sand hills.

ERAGROSTIS SPECTABILIS (Pursh) Steud. vel aff. Occasional in small scattered stands of the river bottoms.

ERAGROSTIS TRICHODES (Nutt.) Wood. Infrequent along sandy banks of Persimmon Creek.

HORDEUM JUBATUM L. Occasional in the river bottoms and near the mouth of Clear Creek.

HORDEUM PUSILLUM Nutt. Occasional in scattered stands in the river bottoms and adjacent to creeks in the sand hills.

LEERSIA ORYZOIDES (L.) Sw. Occasional in the river bottoms.

LEPTOLOMA COGNATUM (Schult.) Chase. Occasional and scattered throughout both the river bottoms and the sand hills.

MUHLENBERGIA ASPERIFOLIA (N. & M.) Parodi. Occasional in the drier portions of the river bottoms and in the gravel ridges adjacent to the bottoms.

MUNROA SQUARROSA (Nutt.) Torr. Occurring in relatively dense stands in several scattered areas of tight soil in the sand hills.

PANICUM CAPILLARE L. In occasional dense stands adjacent to Clear and Persimmon Creeks in the sand hills.

PANICUM LINDHEIMERI Nash. Infrequent in tight loam of the river bottoms.

PANICUM OBTUSUM H.B.K. Locally frequent in the river bottoms especially in the overflow area at the mouth of Clear Creek.

PANICUM OLIGOSANTHES Schult. var. HELLERI (Nash) Fern. Infrequent along the banks of Persimmon Creek.

PASPALUM CILIATIFOLIUM Michx. Occasional in deep sands of the sand hills.

PASPALUM DISTICHUM L. Occasional in drier areas of the river bottoms.

PHRAGMITES COMMUNIS Trin. In scattered dense stands on the banks of the Canadian River.

POLYPOGON MONSPELIENSIS (L.) Desf. Infrequent near the mouth of Clear Creek and along waterways in the river bottoms.

SETARIA GENICULATA (Lam.) Beauv. Occasional near moist areas throughout the area.

SETARIA VIRIDIS (L.) Beauv. Infrequent in small stands near waterways in the river bottoms.

SORGHASTRUM NUTANS (L.) Nash. Scattered but frequent through-out the river bottoms.

SORGHUM HALEPENSE (L.) Pers. Occasional in disturbed areas and along waterways through-out the area.

SPARTINA PECTINATA Link. Occasional in dense stands scattered throughout the river bottoms.

SPHENOPHOLIS OBTUSATA (Michx.) Scribn. Infrequent in the river bottoms.

SPOROBOLUS AIROIDES Torr. Occasional in the river bottoms and adjacent sand hills.

SPOROBOLUS CRYPTANDRUS (Torr.) A. Gray. Frequent, scattered through-out the sand hills and drier portions of the river bottoms.

SPOROBOLUS GIGANTEUS Nash. Frequent, scattered through-out the sand hills and drier portions of the river bottoms.

TRIDENS FLAVUS (L.) Hitchc. Occasional in deep sands along Persimmon Creek bed.

TRIDENS PILOSUS (Buckl.) Hitchc. Occasional in deep sands of the sand hills.

TRIPLASIS PURPUREA (Walt.) Chapman. Occasional in deep sands of the sand hills.

TRIPSACUM DACTYLOIDES L. In frequent, scattered stands throughout the river bottoms.

CYPERACEAE

CAREX ANNECTENS Bicknell. Occasional in moist areas of the river bottoms and near the mouth of Clear Creek.

CAREX LANUGINOSA Michx. Occasional in moist areas adjacent to waterways in the river bottoms.

CYPERUS ARISTATUS Rottb. vel aff. Infrequent in moist sandy loam near garden area in overflow region of Clear Creek.

CYPERUS FENDLERIANUS Boeckl. Infrequent in swales between hills in the sand hills.

CYPERUS STRIGOSUS L. Occasional in Clear Creek margins.

ELEOCHARIS CALVA Torr. vel aff. In scattered sparse stands near mouth of Clear Creek.

ELEOCHARIS MACROSTACHYA Britton. In scattered dense stands in the river bottoms.

FUIRENA SIMPLEX Vahl. Scattered along creek beds and the river bottoms.

SCIRPUS AMERICANUS Pers. In scattered stands along waterways and moist areas of the river bottoms.

SCIRPUS PALUDOSUS A. Nels. In moist areas of the river bottoms. Occasional to frequent.

SCIRPUS VALIDUS Vahl. In moist areas of the river bottoms. Occasional to locally frequent.

LEMNACEAE

LEMNA MINOR L. In ponds and slow-moving water of Clear Creek.

SPIRODELA POLYRHIZA (L.) Schleid. In ponds and slow-moving water of Clear Creek.

COMMELINACEAE

COMMELINA ERECTA L. var. ANGUSTIFOLIA (Michx.) Fern. Common in drier portions of the river bottoms and the sand hills adjacent to them.

TRADESCANTIA OCCIDENTALIS Britton. Occasional in moist sandy areas of the river bottoms and the adjacent sand hills.

JUNCACEAE

JUNCUS BALTICUS Willd. Occasional in moist areas of the river bottoms.

JUNCUS INTERIOR Wiegand. Occasional in moist banks of Persimmon and Clear Creeks and along waterways in the river bottoms.

JUNCUS TORREYI Cov. Occasional in moist banks of Clear Creek.

LILIACEAE

YUCCA ANGUSTIFOLIA Pursh. Occasional to locally frequent in gravel banks adjacent to the river bottoms.

IRIDACEAE

SISYRINCHIUM ENSIGERUM Bicknell. Occasional in moist sandy loam of the river bottoms.

ORCHIDACEAE

SPIRANTHES VERNALIS Engelm. & Gray. Infrequent in meadows of the river bottoms.

SALICACEAE

POPULUS DELTOIDES Marsh. var. OCCIDENTALIS Rydb. Frequent large trees in the river bottoms and riparian associations of creeks.

POPULUS TEXANA Sarg. Frequent large trees in the river bottoms and riparian associations of creeks.

SALIX AMYGDALOIDES Anderss. Small to medium large tree in the river bottoms.

SALIX INTERIOR Rowlee. Locally abundant shrubs along the banks of the Canadian River.

FAGACEAE

QUERCUS HAVARDII Rydb. Represented on the area studied by a few, small, scattered stands on gravel banks adjacent to the river bottoms.

ULMACEAE

CELTIS RETICULATA Torr. Occasional small trees in the sand hills and the river bottoms.

ULMUS PUMILA L. Medium trees near old ranch headquarters in the river bottoms.

MORACEAE

MORUS ALBA L. Locally frequent trees in the river bottoms.

MACLURA POMIFERA (Raf.) Schneid. Occasional trees in the river bottoms.

URTICACEAE

BOEHMERIA CYLINDRICA (L.) Willd. var. DRUMMONDIANA Weddell. Infrequent in moist soil along Persimmon Creek in the sand hills.

POLYGONACEAE

ERIOGONUM ANNUUM Nutt. Locally frequent in drier portions of the river bottoms and adjacent sand hills.

POLYGONUM COCCINEUM Muhl. var. PRATINCOLA (Greene) Stanford. Occasional to locally frequent along the margins of Clear Creek.

POLYGONUM HYDROPIPEROIDES Michx. var. HYDROPIPEROIDES. Occasional along margins of Persimmon Creek in the sand hills.

POLYGONUM LAPATHIFOLIUM L. Occasional along margins of Clear Creek in the river bottoms.

RUMEX ALTISSIMUS Wood. Infrequent along waterways in the river bottoms, along Clear and Persimmon Creeks in the sand hills.

RUMEX CRISPUS L. Occasional along waterways in the river bottoms.

CHENOPODIACEAE

CHENOPODIUM DESICCATUM A. Nels. var. LEPTOPHYLLOIDES (Murr) Wahl. Occasional in drier portions of the river bottoms and in the sand hills.

CHENOPODIUM FREMONTII S.Wats. Infrequent in drier portions of the river bottoms.

CHENOPODIUM HYBRIDUM L. var. GIGANTOSPERMUM (Aellen) Rouleau. Occasional to locally abundant in the shade of trees in the river bottoms.

CYCLOLOMA ATRIPLICIFOLIUM (Spreng.) Coulter. Occasional throughout the sand hills and drier portions of the river bottoms.

KOCHIA SCOPARIA (L.) Schrad. Scattered, infrequent throughout the sand hills and river bottoms.

SALSOLA PESTIFER A.Nels. Locally dense stands scattered throughout the sand hills and river bottoms.

AMARANTHACEAE

AMARANTHUS ALBUS L. Locally abundant along margins of prairie dog town in the sand hills.

AMARANTHUS GRAECIZANS L. Locally abundant along margins of prairie dog town.

AMARANTHUS RETROFLEXUS L. Occasional in sparse stands in both the sand hills and river bottoms.

FROELICHIA CAMPESTRIS Small. Infrequent dense stands in the sand hills.

FROELICHIA GRACILIS (Hook.) Moq. Infrequent dense stands in the sand hills.

TIDESTROMIA LANUGINOSA (Nutt.) Standl. Infrequent dense stands in sand hills and gravel banks adjacent to the river.

NYCTAGINACEAE

ABRONIA FRAGRANS Nutt. Occasional scattered plants in the sand hills and in disturbed areas of sands in the river bottoms.

MIRABILIS EXALTATA Standl. Infrequent, scattered throughout the sand hills.

MIRABILIS LINEARIS (Pursh) Heimerl. Infrequent, scattered throughout the sand hills.

PHYTOLACCACEAE

PHYTOLACCA AMERICANA L. Infrequent in the river bottoms.

AIZOACEAE

MOLLUGO VERTICILLATA L. Infrequent scattered stands in both the sand hills and drier portions of the river bottoms.

PORTULACACEAE

PORTULACA PILOSA L. Occasional in deep sands adjacent to Persimmon Creek and lower margins of the sand hills.

CARYOPHYLLACEAE

PARONYCHIA JAMESII T. & G. Occasional, scattered throughout the sand hills.

CERATOPHYLLACEAE

CERATOPHYLLUM DEMERSUM L. Occasional to locally abundant in still ponds near the mouth of Clear Creek.

PAPAVERACEAE

ARGEMONE INTERMEDIA Sweet. Infrequent, scattered in both the sand hills and river bottoms.

CAPPARIDACEAE

CLEOME SERRULATA Pursh. Infrequent in the river bottoms.
CLEOMELLA ANGUSTIFOLIA Torr. Infrequent in the river bottoms.
CRISTATELLA JAMESII T. & G. Infrequent, scattered in the sand hills.

CRUCIFERAE

DESCURAINIA PINNATA (Walt.) Britt. Occasional scattered stands in disturbed areas of the river bottoms.

DITHYREA WISLIZENI Engelm. var. PALMERI Payson. Scattered, frequent in both the sand hills and drier portions of the river bottoms.

LEPIDIUM VIRGINICUM L. Scattered stands occasional along waterways in the river bottoms.

LESQUERELLA GORDONII (A.Gray) S.Wats. In infrequent dense stands in drier areas of the river bottoms.

NASTURTIUM OFFICINALE R.Br. Infrequent in moving water near the mouth of Clear Creek.

RORIPPA ISLANDICA (Oeder) Borbas. Infrequent in moving water near the mouth of Clear Creek.

SISYMBRIUM ALTISSIMUM L. Infrequent along margins of Clear Creek near its mouth.

SAXIFRAGACEAE

RIBES ODORATUM Wendl. Infrequent in the river bottoms.

ROSACEAE

AGRIMONIA PARVIFLORA Ait. Infrequent along moist margins of Persimmon Creek in the sand hills.

PRUNUS ANGUSTIFOLIA Marsh. Abundant in stands throughout the sand hills.

ROSA ARKANSANA Porter. Very infrequent along banks of Persimmon Creek in the sand hills.

LEGUMINOSAE

AMORPHA CANESCENS (Nutt.) Pursh. Occasional, scattered in the sand hills.

AMORPHA FRUTICOSA L. var. ANGUSTIFOLIA Pursh. Infrequent in scattered stands along waterways in the river bottoms.

BAPTISIA MINOR Lehm. Occasional, scattered in the sand hills.

CASSIA FASCICULATA Michx. var. ROSTRATA (W. & S.) Turner. Frequent but scattered in the sand hills and drier portions of the river bottoms.

DALEA LANATA Spreng. Infrequent, scattered in loose, deep sands in the sand hills.

DALEA LAXIFLORA Pursh. Infrequent in the sand hills, gravel banks and river bottoms.

DALEA NANA Torr. Infrequent in loose, deep sands of the sand hills.

DALEA OLIGOPHYLLA (Torr.) Shinners. Occasional in the sand hills, gravel banks and river bottoms.

DALEA TENUIFOLIA (Gray) Shinners. Occasional in the sand hills.

DALEA VILLOSA (Nutt.) Spreng. Infrequent in deep, loose sands of the sand hills.

DESMANTHUS ILLINOENSIS (Michx.) MacM. Locally frequent along disturbed areas between the sand hills and the river bottoms.

GLYCYRRHIZA LEPIDOTA Pursh. Frequent but scattered through the river bottoms and adjacent sand hills.

HOFFMANSEGGIA JAMESII T. & G. Infrequent, scattered over the sand hills.

INDIGOFERA LEPTOSEPALA Nutt. Occasional, scattered in the sand hills and drier portions of the river bottoms.

LESPEDEZA CAPITATA Michx. Two plants observed beside pond in Clear Creek near old ranch headquarters.

LESPEDEZA STUEVEI Nutt. Infrequent, scattered in the sand hills.

MEDICAGO SATIVA L. Infrequent beside pond in Clear Creek near old ranch headquarters.

MELILOTUS ALBA Desr. Occasional in the river bottoms.

PSORALEA LINEARIFOLIA T. & G. Occasional in loose sand of the sand hills and along gravel banks.

ROBINIA PSEUDO-ACACIA L. Several large trees in the river bottoms near old homesite.

SCHRANKIA NUTTALLII (DC.) Standl. Occasional, scattered throughout the sand hills and drier portions of the river bottoms.

TEPHROSIA VIRGINIANA (L.) Pers. Occasional over the sand hills.

LINACEAE

LINUM RIGIDUM Pursh, var. BERLANDIERI (Hook.) T. & G. Occasional, scattered in drier portions of the river bottoms.

ZYGOPHYLLACEAE

TRIBULUS TERRESTRIS L. Occasional to locally frequent in disturbed areas of the sand hills and river bottoms.

EUPHORBIACEAE

CHAMAESYCE FENDLERI (T. & G.) Small. Occasional, scattered in the sand hills.

CHAMAESYCE GLYPTOSPERMA (Engelm.) Small. Occasional, scattered in the sand hills.

CHAMAESYCE MACULATA (L.) Small. Infrequent in the sands bordering Persimmon Creek.

CHAMAESYCE MISSURICA (Raf.) Shinners var. MISSURICA. Occasional, scattered in the sand hills.

CROTON TEXENSIS (Kl.) Muell.-Arg. Frequent in tight sands of the sand hills and the drier portions of the river bottoms.

EUPHORBIA DENTATA Michx. Occasional in tight sands of the sand hills and the river bottoms.

EUPHORBIA HEXAGONA Nutt. Infrequent in gravel banks adjacent to the river bottoms.

EUPHORBIA MARGINATA Pursh. Locally abundant in the river bottoms.

STILLINGIA SYLVATICA L. Occasional in sands of the sand hills and drier portions of the river bottoms.

ANACARDIACEAE

RHUS AROMATICA Ait. var. PILOSISSIMA (Engler) Shinners. Occasional to locally abundant in loose sands of the sand hills and river bottoms.

RHUS GLABRA L. Locally frequent along the banks of Persimmon and Clear Creeks in the sand hills.

TOXICODENDRON RADICANS (L.) Kuntze. Locally abundant in wooded areas adjacent to creeks and in the river bottoms.

ACERACEAE

ACER SACCHARUM Marsh. vel. aff. Rare medium trees near old homesite in the river bottoms.

SAPINDACEAE

CARDIOSPERMUM HALICACABUM L. In wooded areas near creeks in the sand hills and the river bottoms. Occasional.

SAPINDUS DRUMMONDII H. & A. Locally abundant near creeks in the sand hills and in the river bottoms.

VITACEAE

AMPELOPSIS CORDATA Michx. Occasional in wooded areas near creeks in the sand hills and in the river bottoms.

PARTHENOCISSUS VITACEA (Knerr) Hitchc. Occasional in wooded areas near creeks in the sand sills and in the river bottoms.

VITIS ACERIFOLIA Raf. Locally abundant in wooded areas of the river bottoms

MALVACEAE

CALLIRHOE INVOLUCRATA (T. & G.) A.Gray. Occasional, scattered in both the sand hills and river bottoms.

HIBISCUS LASIOCARPUS Cav. Locally abundant in one moist meadow area of the river bottoms.

HIBISCUS MILITARIS Cav. Locally abundant in one moist meadow area in the river bottoms.

MALVA NEGLECTA Wallr. Occasional in disturbed area of garden plot near mouth of Clear Creek.

SPHAERALCEA ANGUSTIFOLIA (Cav.) Don. Occasional in tight soils of the drier portions of the river bottoms.

SPHAERALCEA COCCINEA (Nutt.) Rydb. Locally abundant in and around the prairie dog town in the sand hills.

TAMARICACEAE

TAMARIX GALLICA L. Occasional to locally frequent in river bottoms especially adjacent to waterways.

LOASACEAE

MENTZELIA STRICTA (Osterhout) Stevens. Frequent, scattered in the sand hills.

CACTACEAE

ECHINOCEREUS sp. Occasional in tight soils of the sand hills and drier portions of the river bottoms.

OPUNTIA MACRORHIZA Engelm. Occasional in sands in the sand hills.

ONAGRACEAE

GAURA COCCINEA Pursh. Occasional, scattered in deep sands of the sand hills.

GAURA PARVIFLORA Dougl. var. PARVIFLORA. Occasional, scattered in both the sand hills and the river bottoms.

GAURA VILLOSA Torr. Infrequent in tight sands of the sand hills and river bottoms.

OENOTHERA ENGELMANNII (Small) Munz. In loose sands adjacent to the river bottoms.

OENOTHERA HETEROPHYLLA Spach. var. RHOMBIPETALA (Nutt.) Fosberg. Frequent in gravel banks and tight sands in the sand hills.

OENOTHERA JAMESII T. & G. Occasional in sands adjacent to Clear Creek.

OENOTHERA LACINIATA Hill var. GRANDIFLORA (S.Wats.) Robins. Locally frequent in sands adjacent to Clear Creek as it enters the river bottoms.

OENOTHERA SERRULATA Nutt. Frequent throughout the area.

STENOSIPHON LINIFOLIUM (Nutt.) Heynh. Infrequent in gravel banks.

UMBELLIFERAE

AMMOSELINUM POPEI T. & G. Locally abundant in moist meadow area of the river bottoms.

CICUTA MACULATA L. Locally abundant in moist meadow of the river bottoms.

CORNACEAE

CORNUS DRUMMONDII C.Meyer. Small trees locally abundant in riparian associations of Clear and Persimmon Creeks.

EBENACEAE

DIOSPYROS VIRGINIANA L. Frequent in riparian associations of Clear and Persimmon Creeks and in the river bottoms.

PRIMULACEAE

SAMOLUS CUNEATUS Small. Infrequent in moist meadow areas of the river bottoms.

GENTIANACEAE

EUSTOMA GRANDIFLORUM (Raf.) Shinners. Locally abundant in tight soils along waterways in the river bottoms.

APOCYNACEAE

APOCYNUM SIBIRICUM Jacq. Infrequent, scattered in loose sands of the sand hills and drier portions of the river bottoms.

ASCLEPIADACEAE

ASCLEPIAS ARENARIA Torr. Locally frequent in tight sandy loam of the river bottoms and adjacent sand hills.

ASCLEPIAS ASPERULA (Dcne.) Woodson var. DECUMBENS (Nutt.) Shinners. Occasional in sands of the sand hills.

ASCLEPIAS INCARNATA L. var. INCARNATA. Infrequent in riparian association of Clear Creek in the sand hills.

ASCLEPIAS PUMILA (Gray) Vail. Infrequent in sands in the sand hills.

ASCLEPIAS SPECIOSA Torr. Several scattered stands in moist meadow sites of the river bottoms.

ASCLEPIAS TUBEROSA L. Infrequent in deep loose sands of the sand hills adjacent to the river bottoms.

ASCLEPIAS VIRIDIFLORA Raf. Occasional in tight sandy soil of the river bottoms.

CONVOLVULACEAE

CUSCUTA CUSPIDATA Engelm. In several dense stands in both the sand hills and river bottoms.

IPOMEA LEPTOPHYLLA Torr. Occasional in deep sands in the sand hills.

IPOMEA PURPUREA (L.) Roth. Infrequent near disturbed area of garden near mouth of Clear Creek in the river bottoms.

POLEMONIACEAE

GILIA LONGIFLORA (Torr.) Don. Infrequent in deep sands of the sand hills.

BORAGINACEAE

CRYPTANTHA JAMESII (Torr.) Payson. Occasional to frequent in tight sands of the sand hills and drier portions of the river bottoms.

CRYPTANTHA MINIMA Rydb. Occasional in tight sands of the sand hills and drier portions of the river bottoms.

HELIOTROPIUM CONVOLVULACEUM (Nutt.) A.Gray. Frequent in loose sands along contact between sand hills and river bottoms.

LAPPULA REDOWSKII (Hornem.) Greene. Occasional in loose sands of the sand hills.

LITHOSPERMUM CAROLINIENSE (Walt.) MacM. Occasional in loose sands of the sand hills and drier portions of the river bottoms.

VERBENACEAE

PHYLA LANCEOLATA (Michx.) Greene. Frequent throughout the moist portions of the river bottoms and moist banks of Clear and Persimmon Creeks.

VERBENA BRACTEATA Lag. & Rodr. Locally abundant along margins of prairie dog towns.

VERBENA HASTATA L. Locally frequent near waterways of the river bottoms.

VERBENA STRICTA Vent. Occasional in moist meadow areas of the river bottoms.

LABIATAE

LYCOPUS AMERICANUS Michx. Locally abundant in moist meadow area in the river bottoms.

LYCOPUS ASPER Greene. Locally abundant in moist meadow in the river bottom.

MENTHA ARVENSIS L. Locally abundant in moist meadow in the river bottom.

MONARDA PUNCTATA L. var. OCCIDENTALIS (Epl.) Palmer & Steyerm. Seasonally abundant in sands throughout the area.

SALVIA AZUREA Lam. var. GRANDIFLORA Benth. Occasional in deep sands of the sand hills.

SCUTELLARIA GALERICULATA L. Infrequent in moist meadow areas of the river bottoms.

SCUTELLARIA LATERIFLORA L. Occasional in moist meadow areas and along moist banks of Clear and Persimmon Creeks.

SCUTELLARIA RESINOSA Torr. Infrequent in tight sandy loam in drier portions of the river bottoms.

TEUCRIUM CANADENSE L. Occasional in moist meadow areas of the river bottoms.

SOLANACEAE

DATURA STRAMONIUM L. Occasional in disturbed areas along roadside between sand hills and river bottoms.

PHYSALIS LONGIFOLIA Nutt. Locally frequent in moist meadow areas of the river bottoms.

PHYSALIS PENDULA Rydb. Locally frequent in moist areas of the river bottoms.

SOLANUM AMERICANUM Mill. Occasional in sands of the sand hills.

SOLANUM ELAEAGNIFOLIUM Cav. Locally abundant in swales in the sand hills and in drier portions of the river bottoms.

SOLANUM ROSTRATUM Dunal. Occasional in the river bottoms.

SOLANUM TRIFLORUM Nutt. Locally abundant in disturbed area of the prairie dog town.

SCROPHULARIACEAE

PENSTEMON FENDLERI T. & G. Infrequent in the gravel banks adjacent to the river bottoms.

BIGNONIACEAE

CATALPA SPECIOSA Warder. Several large trees in the vicinity of old ranch headquarters near the mouth of Clear Creek.

MARTYNIACEAE

MARTYNIA LOUISIANICA Mill. Infrequent in disturbed areas along roadside in the river bottoms and in the prairie dog town.

PLANTAGINACEAE

PLANTAGO PURSHII R. & S. var. PURSHII. Locally abundant in dry tight sandy loam of the river bottoms.

PLANTAGO PURSHII R. & S. var. BREVISCAPA Shinners. Locally abundant in tight sandy loam in sand hills near Persimmon Creek.

RUBIACEAE

CEPHALANTHUS OCCIDENTALIS L. Locally abundant in wooded areas of the river bottoms.

HOUSTONIA HUMIFUSA A.Gray. Seasonally abundant throughout the sand hills.

CUCURBITACEAE

CUCURBITA FOETIDISSIMA H.B.K. Occasional in both the sand hills and river bottoms, most often in disturbed areas.

LOBELIACEAE

LOBELIA CARDINALIS L. var. PHYLLOSTACHYA (Engelm.) McVaugh. Infrequent in moist sand along margins of Persimmon Creek and near the mouth of Clear Creek.

COMPOSITAE

ACHILLEA MILLEFOLIUM L. Occasional stands in sandy loam of the river bottoms.

AMBROSIA PSILOSTACHYA DC. Occasional to locally abundant in tight sandy loam of the river bottoms and creek riparian.

AMBROSIA TRIFIDA L. Locally abundant in tight sandy loams of the river bottoms.

APHANOSTEPHUS SKIRRHOBASIS (DC.) Trel. Seasonally abundant in sands of the sand hills and the river bottoms.

ARTEMISIA FILIFOLIA Torr. Abundant throughout the sand hills and drier portions of the river bottoms.

ASTER SPINOSUS Benth. Locally abundant in loose sands along river banks and along roadsides near river.

ASTER SUBULATUS Michx. var. LIGULATUS Shinners. Occasional in moist sandy loam along Clear and Persimmon Creeks in the sand hills.

BACCHARIS SALICINA T. & G. Locally abundant along river banks and waterways of the river bottoms.

BERLANDIERA TEXANA DC. Occasional in sands of the sand hills and in the gravel banks adjacent to the river bottoms.

CIRSIUM OCHROCENTRUM A.Gray. Occasional in meadows in the river bottoms.

CONYZA CANADENSIS (L.) Cronquist var. CANADENSIS. Occasional in tight dry soils of the river bottoms.

CROPTILON DIVARICATUM (Nutt.) Raf. var. HOOKERIANUM (T. & G.) Shinners. Occasional, scattered throughout the sand dunes.

ECLIPTA ALBA (L.) Hassk. Locally abundant in moist sandy loam adjacent to mouth of Clear Creek.

ENGELMANNIA PINNATIFIDA T. & G. Occasional, scattered in the sand hills.

ERIGERON BELLIDIASTRUM Nutt. Occasional, scattered in the sand hills.

EUPATORIUM PERFOLIATUM L. Locally abundant near waterways in the river bottoms and riparian associations of the creeks.

EUTHAMIA CAMPORUM Greene. Occasional in sands of the sand hills and adjacent to Persimmon Creek.

EVAX PROLIFERA Nutt. In scattered stands in the sand hills and drier portions of the river bottoms.

FLAVERIA CAMPESTRIS J.R.Johnston. Occasional in disturbed areas along roadsides in the river bottoms.

GAILLARDIA PULCHELLA Foug. Occasional in tight sandy loam of the river bottoms and adjacent sand hills.

GRINDELIA LANCEOLATA Nutt. Occasional, scattered over the drier portions of the river bottoms.

HELENIUM AUTUMNALE L. Occasional, scattered in the sand hills.

HELIANTHUS ANNUUS L. Occasional to locally abundant in drier portions of the river bottoms.

HELIANTHUS MAXIMILIANI Schrad. Occasional in sands of disturbed areas of the river bottoms.

HELIANTHUS PETIOLARIS Nutt. Locally abundant in tight sandy loam in the river bottoms.

HETEROTHECA STENOPHYLLA (Gray) Shinners. Occasional in deep sands of the sand hills.

HYMENOPAPPUS FLAVESCENS A.Gray. Infrequent, scattered over the sand hills and drier portions of the river bottoms.

HYMENOPAPPUS TENUIFOLIUS Pursh. Infrequent, scattered in the deep sands of the sand hills.

HYMENOXYS GLABRA (Nutt.) Shinners. Occasional, scattered in the deep sands of the sand hills.

IVA CILIATA Willd. Locally abundant in disturbed areas of the river bottoms.

IVA XANTHIFOLIA Nutt. Locally abundant in disturbed areas of the river bottoms.

KUHNIA EUPATORIOIDES L. var. CORYMBULOSA T. & G. Infrequent in the disturbed area of the prairie dog town.

LACTUCA SERRIOLA L. Infrequent in disturbed areas along roadsides in the river bottoms.

LIATRIS GLABRATA Rydb. var. GLABRATA. Locally frequent in tight gravel loam of hills north of Persimmon Creek.

LIATRIS PUNCTATA Hook. Infrequent in tight sandy loam and gravel of the gravel banks and adjacent river bottoms.
turbed sandy areas along roadsides in the river bottoms.

MACHAERANTHERA TANACETIFOLIA (H.B.K.) Nees. Occasional in disturbed sandy areas along roadsides in the river bottoms.

MELAMPODIUM LEUCANTHUM T. & G. Occasional to locally frequent in tight sands of the sand hills and gravel banks.

PALAFOXIA SPHACELATA (Nutt.) Cory. Infrequent, scattered in sands of the sand hills and the river bottoms.

PLUCHEA CAMPHORATA (L.) DC. Occasional along waterways in the river bottoms.

PRIONOPSIS CILIATA Nutt. Occasional, scattered over the sand hills.

PYRRHOPAPPUS GRANDIFLORUS Nutt. Occasional, scattered over the sand hills.

PYRRHOPAPPUS ROTHROCKII A.Gray. Occasional in moist meadows of the river bottoms.

RATIBIDA COLUMNARIS (Pursh) Raf. Occasional in tight sandy loams of the sand hills and river bottoms.

SOLIDAGO GIGANTEA Ait. Occasional in riparian association of Persimmon Creek.

SOLIDAGO GLABERRIMA Martens. Occasional in riparian association of Clear and Persimmon Creeks.

SONCHUS ASPER (L.) Hill. Occasional in moist sandy loam near garden in river bottoms.

THELESPERMA SIMPLICIFOLIUM A.Gray. Occasional, scattered in sands of the sand hills and drier portions of the river bottoms.

VERNONIA BALDWINII Torr. Locally abundant along waterways and disturbed areas of the river bottoms.

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NOTES

CELTIS SPINOSA SPRENGEL VAR. **pallida** (Torrey) M. C. Johnston, new combination. Based on *Celtis pallida* Torr. in Emory, Rept. Surv. U.S. & Mex. Bound. 2: 203. 1859. "Common in Western Texas and along the Rio Grande, from Fort Duncan to the Gulf, and west to Magdalena in Sonora." LECTOTYPE: *Wright 1858* (NY). Torrey also cites as second collection *Berlandier 3021;* no definite locality is cited for either one. Synonym: *Celtis Tala* Gillies var. *pallida* (Torr.) Planchon in DC., Prodr. 17: 191, 1873. Since *Celtis Tala* Gillies ex Planchon, 1848 (or 1849, according to Baehni), is later than Sprengel's name for the South American "Tala," Planchon's combination, revived by Benson (Amer. Journ. Bot. 30: 236, 1943), cannot be used for our plants (already pointed out by I. M. Johnston, Journ. Arn. Arb. 25: 451, 1944). Our variety occurs from Oaxaca northwest through San Luis Potosi and Sinaloa to Baja California, southern Arizona, and southern Texas (north at least to Travis County). In southern Texas the plants are some of the very most abundant shrubs of deep brush, and are among the first to appear in clay and sandy loam prairies as they become brushed over. In spite of their abundance, they are not very commonly collected, presumably because of the ferocious spines. C. Baehni (Candollea 7: 202–205, 1937) was apparently the latest to treat the species in a broad sense, but his account deals only with its status in South America. *Celtis spinosa* Spreng., Syst. Veg. 1: 931, 1825, was described very briefly from "Brasil," without other data. According to Baehni, the holotype, from Sprengel's herbarium, was *Sello 536*, at Berlin. He records var. *spinosa* from Argentina, Bolivia, Brazil, Paraguay, Uruguay, and Venezuela.—*Marshall C. Johnston, Sul Ross State College, Alpine, Texas.*

HETEROTHECA **Bartlettii** (Blake) M. C. Johnston, new combination, based on *Aplopappus Bartlettii* Blake, Journ. Wash. Acad. Sci. 22: 328, 1932. Above La Vegonia near San José, Tamaulipas, alt. 1100 meters, July 3, 1930, *Bartlett 10046* (holotype, University of Michigan Herbarium, not seen; isotype, United States National Herbarium, seen).

Blake, *l.c.*, says: "That plant is perplexingly intermediate between *Aplopappus* and *Chrysopsis*. In appearance and practically all features except the pappus it agrees with *Chrysopsis*, particularly with *C. pilosa* Nutt. The strictly l-seriate pappus, however, makes it necessary to refer it to *Aplopappus*, where the only section that can receive it is *Isopappus*. The two species referred to that section in the late Dr. H. M. Hall's monograph of "Haplopappus" are both annuals and too different from *A. bartlettii* to require detailed comparison. . . ."

I agree with Blake that this plant cannot be received in *Isopappus* (Croptilon). In keeping with the dismemberment of the classical sack-genera, and the regrouping of the species on more natural lines, I think this plant belongs among its relatives, in *Chrysopsis*. Gray, Syn. Fl. 1(2): 53–54, 1884, keys *Chrysopsis* out in two places, once for the plants with double pappus, and again for the species (*Ammodia* Nutt.) with "outer pappus obscure or wanting." *Chrysopsis*, including *Ammodia*, should reasonably be placed in *Heterotheca* (see L. H. Shinners, The North Texas species of *Heterotheca*, including *Chrysopsis*, Field & Lab. 19: 66–71, 1951). *Marshall C. Johnston, Sul Ross State College, Alpine, Texas.*

USE OF CARRION BY THE BEETLE, CANTHON LAEVIS (COLEOPTERA, SCARABAEIDAE).—So far as I have determined, the common tumble beetle, *Canthon laevis*, is supposed to use only dung for the food of its larvae. At least the common references available mention no other materials. On May 3, 1957, I found three of these beetles about a mass of *Scaphiopus holbrooki hurteri* tadpoles which had just died as water seeped from a pool. One beetle was rolling a ball, 2.5 cm. in diameter, consisting of mud and decaying tadpoles and the ground was scuffed up about the amphibian larvae. All three beetles and the ball were collected. The next afternoon several other individuals of *C. laevis* were present here, some digging beneath tadpoles, others rooting about the surface. The whole area had been considerably disturbed and a vertical shaft had been dug under the tadpoles for about an inch. No other beetles had formed balls, so far as I could tell.—*Arthur N. Bragg, Oklahoma Biological Survey, University of Oklahoma, Norman.*

FLOOD DISPERSAL OF BROOK SILVERSIDE, LABIDESTHES SICCULUS.—Recorded instances of animals extending their geographic range are not uncommon. Excluding those brought about by human agency, range extensions are usually accomplished in two ways. There may be a gradual pushing out of the periphery of a known range, as with the armadillo in south-central United States, or there may be a sudden "jump" in geographic range as a result of pioneering advances of a few individuals, as was presumably the case when the cattle egret recently reached the New World. The present note records a third type of range extension that occurred when an ecologic barrier that limited the geographic range of a species was temporarily lifted and allowed a mass invasion of a previously uninhabited area.

The brook silverside (*Labidesthes sicculus*) has long been an inhabitant of the lower parts of the Red River, and abundant as far upstream as Lake Texoma, between Texas and Oklahoma. It was absent from the upper parts of the Red River, in Texas at least, and from the Big Wichita River System and the Little Wichita River, both of which are tributary to the Red River. This statement is made with some confidence because stream surveys and fish inventories in these waters in the past three years, under auspices of the Texas Game and Fish Commission, have resulted in the capture and study of tens of thousands of fish specimens from numerous localities in the mentioned streams. The silverside was conspicuous by its absence. There is no dam or geographic barrier separating Lake Texoma from the upper parts of the Red River but the river is a braided stream and it seems probable that the shallow water and shifting stream bed served as an ecological barrier to the species.

The spring of 1957 was marked by unusually heavy rains and floods. The Red River was at flood for many days and, for the first time in its history, Lake Texoma filled to overflowing. When the flood waters receded the brook silverside was found to be widely distributed throughout the upper Red River System. It is apparent that the species had advanced its range while the river was in flood and the shallows were under many feet of water. Proof that this was a mass invasion was furnished when silversides were found in several pools left by the floods when the water fell.

Reproduction in the migrants was successful and by midsummer silversides were common to abundant in tributaries of the Red River and cut-off pools. By early September most of the cut-off pools had dried up and silversides were to be found only in the deeper parts of the Big Wichita River and the Little Wichita River. No silversides were found in the Salt Fork of the Red River or the Prairie Dog Town Fork of the Red River, both in the Texas Panhandle. Both are shallow, braided rivers

and if the silverside invasion did reach as far as these headwater streams the fishes vanished before detection. In the Big Wichita River System the silverside entered Lake Wichita and is now one of the most common fishes in the lake. The dams which impound Lake Diversion and Lake Kemp, higher up the Big Wichita River, formed barriers to the further spread of the silverside but it may be expected that they will soon be introduced into these lakes as escaped or released fishermen's bait.

Success of the silverside range extension will probably be restricted to lakes, for it seems unlikely that such a deep-water species will survive in the shallow streams and rivers of north-central Texas and the Texas Panhandle. The effective range extension, from Lake Texoma to Lake Wichita, is only a little more than 100 miles air-line. However, silversides are already appearing in the offerings of commercial bait dealers and in a relatively short time should be spread by fishermen through the many artificial lakes of northern Texas.—*Walter W. Dalquest, Midwestern University, Wichita Falls, Texas.*

NOTES ON THE MEXICAN SHREW MEGASOREX GIGAS (MERRIAM).—When Hibbard (Contr. Mus. Paleo. Univ. Michigan, 8(6): 127–129, 1950) described the genus *Megasorex*, of which *Notiosorex gigas* Merriam is the genotype, only four specimens were known to science. Three of them (the type with skin and imperfect skull, one skin only, and one skull only) were collected in March, 1897, at Milpillas, 3850 feet, near San Sebastian, Jalisco; the fourth (skin and skull) was taken at Los Reyes, 4800 feet, Michoacán, in 1903. Subsequently, no additional specimens had become available for study until 1956 when I received a specimen with imperfect skull that was collected November 6, 1955, near Acahuizotla, Guerrero. Since then I have received eight additional specimens, all collected in January and February, 1957, at the same locality. Because of the rarity of this species, it seems appropriate to place on record the following notes and measurements (Tables 1 and 2).

According to Joaquin Villanueva, a local naturalist who collected and prepared the study skins, all of the specimens were captured in metal, Sherman-type live-traps, baited with bits of meat, placed on the first bench above a stream that flows through a steep-sided canyon near the village of Acahuizotla. This area is in the

TABLE 1. *External measurements (in millimeters) and weight (in grams) of nine specimens of* Megasorex gigas *(Merriam) from Acahuizotla, 2800 ft., Guerrero, México*

Mus. No.	Sex	Date	Total Length	Length Tail	Length Hind Foot	Height Ear	Weight
5644	♀?	11/6/55	140	50	15.5	..	...
5824	♀	1/3/57	130	40	15.7	11	11.5
5825	♀	2/5/57	130	45	16.0	10	9.5
5826	♀	2/9/57	133	45	16.0	10	11.7
5827	♀	2/9/57	130	45	16.0	10	11.5
5828	♀?	2/14/57	130	45	16.0	10	9.0
5830	♀	1/25/57	130	45	16.0	8	10.5
5829	♂	2/15/57	125	47	15.5	10	10.5
5831	♂	1/28/57	130	45	16.0	10	12.0

TABLE 2. *Cranial measurements (in millimeters) of the same specimens listed in Table 1*

Mus. No.	Sex	Greatest length of skull	Cranial width	Maxillary breadth	Length of palate from tip of incisor	Length upper tooth row from tip of incisor	Least interorbital width	Width of rostrum	Length mandibular tooth row from tip of incisor
5644	♀?	23+	10+	7.0	11.4	11.1	5.7	3.2	10.0
5824	♀	23.3	10.7	7.1	11.3	10.3	5.6	3.3	9.7
5825	♀	22.8	10.3	6.8	10.8	10.2	5.2	3.2	9.6
5826	♀	23.8	10.7	7.4	11.6	10.8	5.4	3.4	10.0
5827	♀	23.1	10.7	7.2	11.3	10.3	5.3	3.3	9.5
5828	♀?	23.3	10.1	7.0	11.1	10.4	5.2	3.2	10.0
5830	♀	23.5	11.3	7.4	11.5	10.7	5.8	3.1	9.5
5829	♂	23.4	10.4	7.0	11.1	10.5	5.3	3.0	9.5
5831	♂	23.2	10.8	7.1	11.1	10.3	5.7	3.3	9.4

Tropical Deciduous Forest at an elevation of approximately 2800 feet. Although this same area had been trapped intensively by me and my parties on several occasions with Museum Special snap traps, the presence of these shrews was not revealed.

In external appearance the Guerreran specimens are, to me, indistinguishable from those taken in Jalisco and Michoacán half a century ago except that two of them have a small white spot on the left side of the rump and one has a white spot on the right shoulder. The cranial characters do not appear to vary significantly from Hibbard's description.

Present indications are that this shrew is widespread in southwestern Mexico and that it occupies the Tropical Deciduous Forest belt which lies between the Thorn Forest of the Pacific lowlands and the Pine-Oak Forest of the mountains.—*William B. Davis, Department of Wildlife Management, Texas A. and M. College, College Station, Texas.*

SHORTAGE OF SCIENTISTS?[1]—There has been considerable publicity regarding the shortage of scientists, saying that insufficient numbers of scientists are being trained at the present time. That this shortage is unequally distributed is rarely mentioned. No doubt those that lament shortages of scientists mean shortages of physicists and mathematicians or shortages of engineers and technicians.

I have personal knowledge only of biologists. A newly fledged Ph.D. in biology, after many years of study, hard work and considerable expense to the institution and to himself, finds that there are few jobs. He may obtain a position if he likes applied research. If not, he has to compete with seventy others for a position at a teachers college that does not want research done, research for which he has been trained. Or he can send letters to all the universities and colleges in the hope of hearing of an opening. If he does, it may be for an instructorship for a year or two (it is cheaper for many colleges to hire a new man every few years than to promote him). Or he may hear of an opening for a physiological cytologist who can also

[1] This was submitted to several national journals and newspapers, but was refused publication by them.—*Editor's note.*

teach a course in ornithology and will do research on the effects of insecticides on wheat. While there are many research grants available, the grants do not help him to obtain a job that permits research to be done.

There has been comment on impending shortages of teachers as universities expand. However, it is far cheaper to hire teaching assistants, students working for their doctorate, than to hire professors. Grants are also available for research assistants or research fellows, who work for a Ph.D. More and more colleges will probably find it less expensive to maintain a large group of Ph.D. candidates than to increase their permanent faculties.

While efforts have been made to raise the salaries of teachers at smaller colleges, one might also suggest that efforts be made to reduce the heavy teaching load and encourage research. Even the most promising researcher cannot be productive if research can only be done at night or in some spare moments on weekends. The reduction of teaching load and the resulting research may not only improve the teaching but may also make a sufficient number of vacancies for the ever-increasing number of scientists who are being trained, scientists who are not interested in applied research or in the physical sciences.—*Herbert W. Levi, Cambridge 38, Massachusetts.*

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REVIEW

THE GENUS NICOTIANA. ORIGINS, RELATIONSHIPS AND EVOLUTION OF ITS SPECIES IN THE LIGHT OF THEIR DISTRIBUTION, MORPHOLOGY AND CYTOGENETICS. Thomas Harper Goodspeed. Chronica Botanica Vol. 16 No. 1/6. Pp. i—xxii, 1—536, with 118 text figures (full page). Waltham, Massachusetts. 1956. $12.50.

For somewhat over forty years, Dr. Thomas Harper Goodspeed has been studying the genus *Nicotiana*. As a long-continued series of papers shows, his interest in this group is not a narrow one. Reports on cytology and genetics have been interspersed with studies of taxonomy and distribution. There is also his very readable *Plant Hunters in the Andes* (Farrar & Rinehart, New York, 1941), which recounts some of the experiences of the several botanical expeditions in western South America under his leadership. This all added up to a wealth of fact, but it needed to be organized and consolidated. We were happy, then, some five or six years ago, to learn that Dr. Goodspeed was preparing such a unified treatment for publication in book form.

Now we have it. Chronica Botanica, Volume 16, Number 1/6, was published in 1956 as a single bound volume entitled "The Genus Nicotiana." Book-wise it is what we have come to expect from the Chronica Botanica Company. It is handsomely designed and impeccably printed on paper of excellent quality, firm and strong in an attractive dark blue buckram binding. It is significant of the trend in American book publishing that the price is a whopping $12.50.

The book covers the various aspects of Dr. Goodspeed's interest in *Nicotiana*. Somewhat more than half the text (180 pages) is devoted to the cytology and genetics of the various taxa. About one third (169 pages) is given over to taxonomy. The balance of the book is divided between morphology (74 pages) and distribution. There is an adequate index. It is unfortunate, I think, that the book is written in the pseudo-objective, ostentatiously impersonal style that is affected by so many American biologists. Aside from being boring to read, this style tends to lend a false impression of authenticity to statements of personal hypothesis.

It is unfortunate that, in general, the author's conclusions from the vast quantity of facts which he presents conform to what he would doubtless call "currently accepted" concepts. Indeed, in many cases the author seems not to admit the existence of alternative hypotheses. Perhaps this narrow view is maintained in order to confine the bulk of the book within reasonable limits. But in a study such as this, in which so many new facts about species and their origins are elucidated, it is particularly unfortunate that such a parochial outlook has been maintained.

We shall all regret, I think, that despite the vast amount of study given to *Nicotiana*, the author has done little toward clarifying the relationships of this genus with other genera in the Solanaceae. Without explicit information, it is difficult to accept without scepticism the repeated assertion that *Petunia* and *Cestrum* are the two most closely allied genera. Likewise, without careful investigation, it is difficult to accept the number 6 as the basic chromosome number in the "pre-generic reservoir" (whatever that may be) of the genus.

To the taxonomist, however, the most important part of the study is embodied in the 169 pages which terminate the exposition: the taxonomic revision. In this Dr. Goodspeed acknowledges the collaboration of Helen-Mar Wheeler and Paul C. Hutchison.

The taxonomic treatment begins with an "Historical Resume." This is primarily devoted to a critical evaluation of post-Linnaean taxonomic studies. Despite the considerable social and medical importance of tobacco before the time of Linnaeus, only a single paragraph is devoted to that period. It should be pointed out that Dr. Goodspeed's description of *Nicotiana Tabacum* does not include two forms well known to pre-Linnaean botanists, the "Sana Sancta Inodora" and "Tabacum minimum," both with unwinged petioles. I cannot help but feel that a fuller discussion of the older cultivars of this interesting species would have been valuable.

The taxonomic treatment proper begins with a generic diagnosis and a key to the subgenera and sections. It is a little surprising that we are nowhere told which of the 60 species recognized in this treatment is considered to be the type of the genus. Also, to conform to the requirements of the International Code of Botanical Nomenclature, one of the subgenera and one of the sections should bear the same name as the genus. This is, of course, an entirely arbitrary rule, and quite contrary to the spirit of priority which governs other names of this kind. It is, however, the rule, and careful botanists should abide by it.

Despite the sumptuous typography and imposing synoptic form of the key to the subgenera and sections, it shows unmistakable evidence of uncritical haste in its composition. The first break, for instance, despite its contrast of four characters, does not give a single firm morphological difference that is usable in the herbarium. Habit, flower color, and floral movements are all characters that are seldom mentioned on herbarium labels, and are not generally observable in the specimens themselves. The character of the inflorescence seems, at first glance, to be a useful one, but when we compare the discussion of inflorescence types (pp. 66–74), the key, and the descriptions, this character loses its appeal.

A key, to be of any value, must be usable. By usable I mean that it should facilitate confident identification of adequate material. (In the case of large, coarse plants, such as most species of *Nicotiana*, this should mean a flowering branch with, perhaps a cauline or basal leaf.) A key ought to be utilitarian: a short-cut to the identification of a specimen. It should lead the user quickly and unequivocally to the description of the material in question. This key to subgenera and sections is theoretically beautifully constructed. It utilizes all sorts of important biological features. Unfortunately it takes a great deal of work before one can use it with any confidence. Presumably there are good morphological distinctions between the subgenera and sections of *Nicotiana*. This key does not facilitate their recognition.

It is only fair to point out that, in marked contrast with the general key, the sectional keys are extremely useful. If one can once get to them, the identification of one's material is generally easy. Also, the value of the treatment is much enhanced by the excellent line drawings of nearly every species. The printed descriptions, too, are clear and, in general, unambiguous.

Any reasonable taxonomic treatment of a genus should attempt to account for all names published in that genus. Index Kewensis lists about 250 specific epithets for *Nicotiana*. The present treatment accounts for only about 200. As nearly as one can tell from the indications in the text, the authors have seen the nomenclatural types of less than half of these. In a day when it is the almost universal practice, amongst herbaria, to lend specimens freely, there is little excuse for any student to fail to see most of the existing types, or at the least, authentic material, of the taxa

with which he is dealing. Further, when an author has expressly designated a type specimen, as Dunal did for example in *Nicotiana Pavonii*, only the loss or destruction of that specimen (which should be explained) would allow a subsequent student to change the typifcation, as Goodspeed and his collaborators have done. Finally, *nomina nuda* and homonyms should be listed and their characterization and disposal expressly indicated. Omission from consideration of such names only makes trouble for all subsequent students.

Two cases of questionable nomenclatural handling call for particular comment. The specific epithet *quadrivalvis* does not appear in the index. The taxon so named is, however, treated as *Nicotiana Bigelovii* var. *quadrivalvis*, an illegitimate name. It was not, as Goodspeed's evidence shows, based on a monstrosity. *Nicotiana quadrivalvis* Pursh (1814) var. *quadrivalvis* is the legitimate name of this taxon, and for the type of the species as delimited by Goodspeed. *N. Bigelovii* (Torr.) S. Wats. (1871) var. *Bigelovii*, as delimited by Goodspeed, bears an illegitimate name. It must be called *N. quadrivalvis* var. **Bigelovii** (Torr.) DeWolf, new comb., based on *N. plumbaginifolia?* var. *Bigelovii* Torr. in Pacific RR. Surv. Rept. 4: 127, 1857. In the case of *Nicotiana pusilla* L., the typification, validity, and legitimacy of the name ought to have been settled. The substitution of the later name *N. plumbaginifolia* Viviani, the type of which apparently was not consulted, seems to me to be extremely bad practice.

Goodspeed, by his own admission, does not cite all or even most of the herbarium material that was examined. Coupled with the inadequacy of his general key, this makes the curating of a collection, or the comparison of material, most difficult. It is a discourtesy to the herbaria whose material he used, as well as to those whose material he did not consult.

However many and however great the defects of this treatment, it does supply us with a great deal of very valuable information. The validity of the conclusions may be questioned; the facts may not. The nomenclature may sometimes disappoint us, but we now have good descriptions and illustrations of nearly all the taxa which comprise the genus. Future workers will find this treatment, like those of Lehmann, Dunal, and Comes, one of their basic tools.—*Gordon P. DeWolf, The Botany School, Downing Street, Cambridge, England.*

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